ACTIVE MATERIAL BASED SEAL ASSEMBLIES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application relates to, and claims priority to, U.S. Provisional Application Ser. No. 60/552,781 filed on Mar. 12, 2004, incorporated herein in its entirety.

BACKGROUND

[0002] This disclosure relates to seals and more particularly, to active material based seal assemblies for sealing opposing surfaces.

[0003] Current methods and assemblies for sealing opposing surfaces such as doors and trunk lids, for example, include the use of flexible elastic membranes and structures that compress upon pressing contact of the opposing surfaces to form a seal. Typical materials include various forms of elastomers, e.g., foams and solids, that are formed into structures having solid and/or hollow cross sectional structures. The geometries of the cross sections are varied and may range from circular forms to irregular forms having multiple slots, various internal cross section geometries, and extending vanes.

[0004] Sealing assemblies are typically utilized for sound, airflow, and/or fluid management. The seals generally are exposed to a variety of conditions. For example, in vehicle applications, door seals generally are exposed to a wide range of temperatures as well as environmental conditions such as rain, snow, sun, humidity conditions, and the like. They must also be resistant to abrasion and repeated cycling. Current materials utilized for automotive seals are passive. That is, other than innate changes in modulus of the seal material due to environmental stimuli, the stiffness and cross sectional geometries of the seal assemblies cannot be remotely changed or controlled.

[0005] Another problem with current seals is the tradeoff in seal effectiveness. Increasing the static interface pressure and/or area of the seal can generally increase seal effectiveness. However, in automotive applications, such as vehicle doors, the increased interface pressure and/or area of the seal can result in increased door opening and closing efforts.

[0006] Accordingly, it is desirable to have active seal assemblies that can be controlled and remotely changed to alter the seal effectiveness, wherein the active seal assemblies actively change shape, orientation and modulus properties. In this manner, in seal applications such as the vehicle door application noted above, door opening and closing efforts can be minimized yet seal effectiveness can be maximized.

BRIEF SUMMARY

[0007] Disclosed herein are active material based seal assemblies. In one embodiment, an active material based seal assembly comprises a seal structure comprising an active material adapted to change at least one attribute in response to an activation signal, wherein the change in the at least one attribute changes a modulus property and/or shape of the seal structure, wherein the active material comprises shape memory alloys, shape memory polymers, electroactive polymers, ferromagnetic shape memory alloys, magnetic materials, electrorheological fluids, electrorheological elastomers, magnetorheological fluids, magnetorheological elastomers, dielectric elastomers, ionic polymer metal composites, piezoelectric polymers, piezoelectric ceramics, various combinations of the foregoing materials; and a controller in operative communication with the active material adapted to selectively provide the activation signal.

[0008] A vehicle comprising at least two opposing surfaces; and an active material based seal assembly intermediate the at least two opposing surfaces, wherein the active material based seal assembly comprises a seal structure comprising an active material adapted to change at least one attribute in response to an activation signal, wherein the change in the at least one attribute changes a modulus property and/or shape of the seal structure, and a controller in operative communication with the active material adapted to selectively provide the activation signal, wherein the change in the at least one attribute changes a dimension of the seal structure.

[0009] The above described and other features are exemplified by the following figures and detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Referring now to the figures, which are exemplary embodiments and wherein like elements are numbered alike:

[0011] **FIG. 1** is a cross section of an active material based seal assembly in accordance with one embodiment, wherein the active seal assembly is in the power-off and power on states;

[0012] **FIG. 2** is a perspective view of an active material based seal assembly in accordance with another embodiment;

[0013] **FIG. 3** is a cross section of an active material based seal assembly in accordance with another embodiment; and

[0014] **FIGS. 4 and 5** are a cross section and perspective view, respectively, of an active material based seal assembly in accordance with another embodiment;

[0015] **FIG. 6** is a cross section of an active material based seal assembly in accordance with another embodiment;

[0016] **FIG. 7** is a cross section of an active material based seal assembly in accordance with another embodiment, wherein the active seal assembly is in the power-off and power on states;

[0017] **FIG. 8** is a cross section of an active material based seal assembly in accordance with another embodiment, wherein the active seal assembly is in the power-off and power on states;

[0018] **FIGS. 9 and 10** are a cross section and perspective view, respectively, of an active material based seal assembly in accordance with another embodiment;

[0019] **FIGS. 11 and 12** are a cross section and perspective view, respectively, of an active material based seal assembly in accordance with another embodiment;

[0020] **FIGS. 13 and 14** are a cross section and a perspective view, respectively, of an active material based seal assembly in accordance with another embodiment;

[0021] **FIG. 15** is a cross section of an active material based seal assembly in accordance with another embodiment;